THE STORY OF SYRPHUS WEIDEMANNI, A FLY, MAGNIFIED IN PLASTIC

By Chris E. Olsen and Dorothy Olsen Davies

In preparation of museum exhibits the preparator, or technician if you prefer, occasionally runs into extremely interesting and exceedingly complicated subjects; subjects that to begin with seem well-nigh impossible. Not impossible of execution, but rather prohibitive in time and cost.

Years ago we, in our Department of Living Invertebrates, decided never to use the term "impossible" in speaking of the preparation of exhibits. There always seemed to be some way in which difficult problems could be overcome, but there was, of course, to be considered time limits and costs.

Personally I feel very fortunate to have been connected with a rather progressive department of a great institution, The American Museum of Natural History, and to have been associated with a curator whose ambition was ever to do the very best in exhibition work. No troubles were too great to make our exhibits scientifically the very best, and no expense was spared to make them technically unsurpassable; as true to nature as possible, and as substantial and permanent as feasible. Every year of these thirty years have been years of learning for me.

It was through my hobby, entomology, that I branched into museum activities from my old line of endeavor, modeling for ornamental decoration, and it was none other than our late curator of the Entomological Department, Dr. Frank E. Lutz, who recommended me to Dr. Roy W. Miner.

Naturally entomology is strongly attached to my career and deeply impressed in my interests in life. I started out by making insect models and would no doubt have continued had not Dr. Miner of the Marine Invertebrate Department grabbed me and pushed me under the sea for thirty years. However every now and then, when my head would pop out of water, there was entomology taking possession of my interests again.

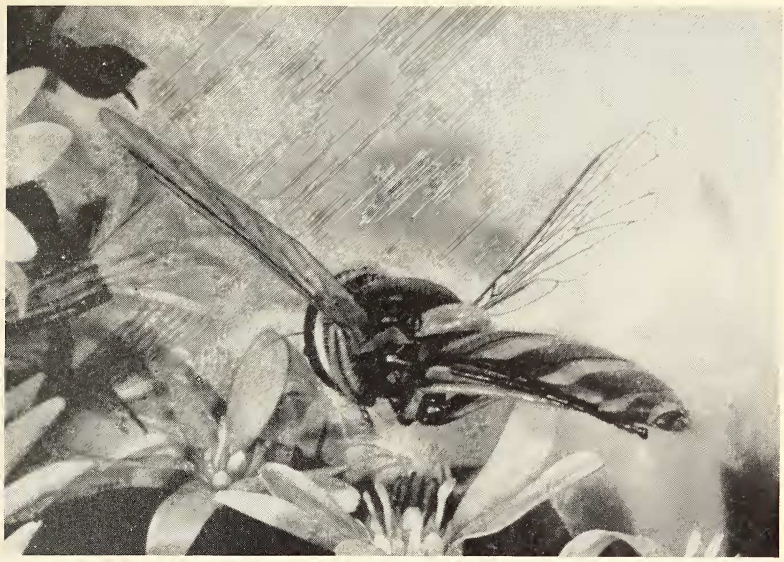
It was early last year, January 1945, to be specific, when ento-

mology again took possession of my interests. This time, however, I had a partner in crime. We ran into one of these extremely interesting and exceedingly complicated problems that I have already mentioned. My oldest daughter, Dorothy Olsen Davies, has for many years been my companion in interesting problems of museum exhibits. She has specialized in small models of marine invertebrates; her models and small marine groups are distributed in many museums and colleges, but she solemnly vowed that she had not the slightest interest in her father's love for bugs. Nevertheless, when this entomological problem of great interest presented itself, she was as enthusiastic as her father. Had she not been so interested I should never have been able to tell you our story, for upon her fell the heavy duty of the job, the actual work and time-consuming experiments, while I could only guide and help solve the problems as they appeared, since I had my time occupied at the Museum each day and could only offer my services part of evenings and weekends.

The problem that now confronted us was a request from the Sperry Gyroscope Company, Incorporated, with their large war plant at Great Neck, Long Island, N. Y. The Sperry Company had become interested in entomology because they had discovered that the fly had invented a gyroscope of its own and they wanted to see what kind of an inventor a fly could be; perchance they could learn something from this invertebrate creature. It is not often that the electrical engineers meddle with branches of natural sciences and of all, entomology, but the halteres of a fly, their movements and stabilization of the creature's flight fascinated them, not from a question of patent rights, for they were quite sure that the fly had no objection to the infringement of its gyroscopic mechanism, but they were curious to know how the fly could have gotten ahead of modern engineers by a few million years, and above all they wanted to know how it worked all this time. One way to find out was to construct an artificial fly as close to a natural fly as it was possible except that it should be magnified to a size where a motor could be placed within its body that would move the halteres at approximately natural motion and speed.

Here in New York City, The American Museum of Natural

History is, of course, the first place where questions on such problems of nature land. Here this question was turned over to the Museum's fly specialist, Dr. C. H. Curran; he in turn came to us and asked if we were interested. Of course we were interested; deeply interested. Even Dot could not resist against her former vows; she had to admit that it was an intensely fascinating problem.



Syrphus weidemanni magnified in plastic.

We doubted, however, that we were equipped for such an undertaking. We also thought a great deal of experimentation would be involved which would naturally make the job a costly one. However, Sperry Co. had made up its mind that it was to be done, and practically offered free reins so far as time and costs were concerned. This fly exhibit was the one remaining item undone that would complete their little Museum Hall at their Great Neck plant. The specific request was as follows: a typical fly, preferably of a showy variety and of fairly good size; magnification to fit a small motor which should be placed within its body for the purpose of moving the halteres; fly should be made in sections to take apart in order to repair in case of motor troubles;

fly to be incorporated in a natural setting of flowers, etc., of similar magnification; concealed wiring with rheostat to control speed movements of halteres; the whole to be assembled into a complete group to be placed on exhibition in the Sperry Company's Museum at Great Neck, L. I., with their numerous other exhibits of gyroscopic invention and allied mechanisms.

It cannot be denied that this was indeed an extremely interesting as well as an exceedingly complicated order. Dr. Curran was encouraging and optimistic, and Mr. Victor Anderson, Chief Engineer of the display exhibits at the Sperry Plant, was most anxious and we were willing to try our best.

The species of fly selected was *Syrphus weidemanni*, a common flower fly of fairly good size and striking color pattern, in which the pale cream-colored halteres were plainly visible against the almost black body. The size of magnification decided on was 32 diameters; in bulk this was equal to 32,768 natural-sized flies.

Now the difficult questions: what material should this model be made of; what material would be substantial enough to hold a motor, and allow for dismantling and assembling at will? Certainly none of the ordinary model materials, such as plaster, wax, papier-mache or wood could be used. The only material that sounded promising was some of the newer forms of plastic. But plastic had never as yet been used in this manner. It meant investigation and experimentation.

Plastic was not uncommon in strictly commercial work where ten thousand or a hundred thousand reproductions were required, but when but a single reproduction is all that is wanted, it is quite another story. In commercial work, thousands of dollars are invested in machinery and equipment to make as simple an item as a button or a buckle, what would it cost to have that machinery and equipment made for the 23 separate parts of a fly model 14 inches in length? The answer would be terrific.

Our problem was not the modeling or sculpturing of the fly from microscopic studies; that was more or less routine work, work that we had done so many times before; a fly, a worm or a sea anemone, all the same, you model and shape that which you see in the microscope; simple enough.

No, our problems were, first to secure the proper plastic ma-

terial to work with. Next, to secure good expert advice on the manipulation of this material. Last, but not least, the problem of building our own equipment for plastic casting in plaster moulds. Our difficulties were increased in the first instance by the fact that it was wartime. Plastic materials were practically impossible to secure for an experimenter. We tried all the plastic concerns and although we told them we were working on a model for the Sperry Gyroscope Company, Inc., it was difficult for them to believe that it had anything to do with the war effort when we began to speak of the model of a fly. What could a fly have to do with the war efforts? It was not until Sperry sent several letters directly to the DuPont Co. that they finally agreed to help us out; in the meantime, several months had elapsed before we finally received a limited amount of material to work with.

Next, the expert advice. Here we really ran up against a snag. Knowing that modern dentures were all done in plastic casting, we investigated this while waiting for material. Fortunately a local dentist allowed us to consult his technician. From this technician we received the rudiments of plastic casting in plaster moulds. When finally we were promised material from DuPont, we were also permitted an interview with a technician at their Arlington, N. J., plant. On our visit here we were introduced to a burly fellow whom we felt was more of an energetic business man than a plastic technician. To this fellow we poured out our anxiety to learn about casting plastic in plaster moulds. I can still see him when he learned our job was only a single casting of a fly model, and when he saw the photographs of our sculptured model, lifting his bushy eyebrows slightly, with a sneaky smile on his lips, announce that material for casting in plaster moulds was of course methacrylate polymer monemer, but he added casting in plaster moulds is much too difficult for such an elaborate object. We should have experience in handling and we must have equipment for heat and pressure. Then he ventured a suggestion. Said he, "Why don't you get a block of lucite and sculpture the object directly?" I don't know whether he tried to be funny or if he wanted to throw us off the track, but I am sure he didn't mean it could be done. Our opinion of this technician was not very good, and we also think that his opinion of

us was none better. I am sure he thought that this was another fellow with a crackpot idea about the use of plastic. However, he had given us the hint of the material used in casting, and that seemed to be all we could expect here.

A friend who happened to learn of our endeavor at hand offered us whatever assistance he was able to contribute to our cause. He was not a practicing technician like our dental technician, but a theoretical student in plastic who was engaged by a law firm as adviser in all actions that had to do with plastic work in any form. What this chap didn't know about plastics, formulas and methods was not worth knowing. To him we went with all our failures and it never failed but that he had a solution to our problem.

At this point we felt we had one and a half solutions to our three major problems solved. Our first problem was solved when we received 10 lb. of methacrylate polymer in grain and corresponding amount of monemer in solution. Problem two, half way cleared through the courtesies of our local dentist and our law firm adviser; the other half would be solved by experiments. The simplest part of the fly to make, the scutellum, was selected for first attempts. Top and bottom, each being about the size of an ordinary denture, was a fair beginning. Accordingly, and before these experiments could proceed, we had to secure the heating apparatus which consisted simply enough of a 3-gallon galvanized iron pail over a gas stove. Each separate piece of the fly had to be made in two parts: top piece and bottom piece which would then be cemented together into one unit with H94 cement. For each of these top pieces and bottom pieces a positive plaster mould and a negative plaster mould had to be made and these positive and negative forms enclosed in iron "flasks" furnished with bolts and nuts to supply the pressure required while cooking the plastic materials. Thus the twenty-three separate parts required forty-six positive and negative forms, many of which had to be made over two, three or more times before we had a fair casting. Fortunately I had worked in the foundry business and knew how the cope and navel or positives and negatives of a flask in casting metal were made. This I applied here. The gradual rise and fall of the temperature while cooking were important. The process must start in cold water and after cooking at boiling

temperature for a set period must gradually cool off. This is very important. Pressure in cooking plastic is as important as temperature, if not more so. The length of cooking to the bulk of material is also important. Any housewife will tell you that when she cooks a Christmas turkey, a twenty-five pound bird will take considerably more time than a fifteen-pound one. This applies here too.

After three or four tries on the scutellum we made a usable set, so we felt that we had problem two licked and, incidentally, also problem three since that problem involved the cooking utensils and flasks for plaster moulds with their pressing devices. But these were only for the smallest and simplest part of the fly. As we began to make the larger sections our difficulties increased proportionately; a three-gallon pail was too small, and we had to bring in service a washboiler. Our nuts and bolts had to be increased in sizes to get the proper pressure. The wings, believe it or not, had to be done over eight times before a good set was made. The head and body also gave us plenty of trouble. Each time a new casting had to be made, it meant a new set of moulds in plaster.

All this accounts for the great amount of time consumed in the building of this fly model and the setting. It was started February 6 and delivered December 26. The handling of plastics is no secret; it is being done every day in great quantities, but there are definite methods that must be followed for the various plastic formulas. Methacrylate polymer is a lucite and non-inflammable, but the monemer that fuses the grain together is highly inflammable. We had only gas heat at our disposal; therefore, to avoid explosion, our product had to be cooked in a water bath, the cause of so many failures.